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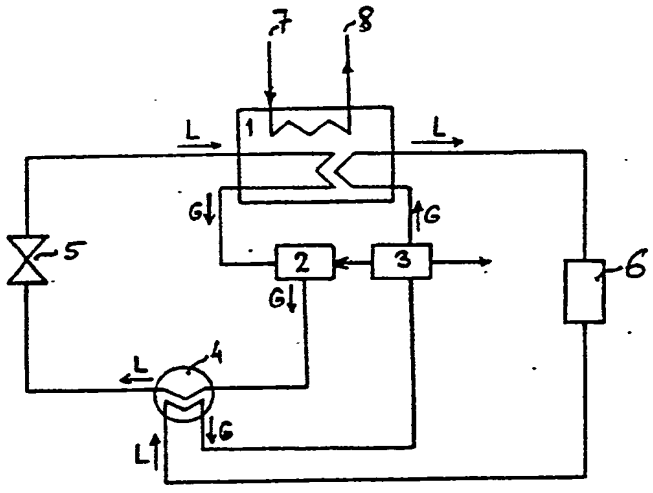

(57) Abstract

System for converting heat energy of a source of practically nonlimited capacity, particularly for utilizing heat energy of the environment, comprising a closed heat pump circuit connected to actuating means (3) for energizing them, wherein the heat pump circuit includes evaporating means (1) receiving heat energy of an outer medium for converting a liquid into vapour, compressing means (2) for increasing pressure of the vapour and condensing means (4) for restituting liquid from the compressed vapour, the system being furnished with an energy output terminal. The essence of the proposed system lies in comprising a closed driving circuit being in thermal contact with the condensing means (4), producing thereby a superheated vapour for energizing the actuating means (3), the driving circuit including means for condensating the superheated vapour leaving the output of the actuating means (3) and transporting means (6) for forwarding the liquid to the condensing means (4). The invented system is capable of utilizing the heat energy of environment without any input from an outer energy source based on electric network or fossil fuel.

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SYSTEM FOR CONVERTING HEAT ENERGY, PARTICULARLY FOR UTILIZING HEAT ENERGY OF THE ENVIRONMENT

BACKGROUND OF THE INVENTION

The invention relates to a system for converting heat energy, particularly for utilizing heat energy of the environment, connected advantageously to a heat energy source of practically nonlimited capacity, as the environment, comprising a closed heat pump circuit connected to actuating means for energizing them, wherein the heat pump circuit includes evaporating means receiving heat energy of an outer medium for converting a liquid into vapour, compressing means for increasing pressure of the vapour and condensing means for restituting liquid from the compressed vapour, the system being furnished with an energy output terminal. The invented system is capable of utilizing the energy of a heat source without any input from another outer energy source based on electric network or fossil fuel. It is also capable of producing energy output disposable for different purposes.

The energy crisis characterising the world economy nowadays has resulted in increasing interests to methods and apparata of low energy consumption. It is especially desired to limit the consumption of the primary energy carriers as coal, natural gas and petrol or electric energy produced therefrom. The fossil and fissile fuels involve increasing political and social problems especially because of being a potential and dangereous source of pollution. The technical revolution which has taken place means also elaborating such solutions of different apparata which

require low energy consumption and methods of finding new energy sources or improving the use of the known ones. The greatest efforts have been made for improving the methods of making use of nuclear energy based on the fissile materials and for developing methods of peaceful utilizing the termonuclear energy. The nuclear energy, however, should be produced only in plants realized with high capital investments. Thus, it is very important to improve the methods of utilizing the solar energy and other disposable non-polluting energy sources.

Especially the solar energy seems to have great perspectives. It can be utilized in a relatively simple manner by different collectors producing warm water for heating buildings and for supplying individual or common consumers or by solid-state solar elements. The solid-state elements have been improved in a spectacular manner.

A highly effective form of utilizing the solar energy is the use of heat pumps having increasing importance. They are based on the second principle of the thermodynamics and assure a relatively high thermal efficiency. By means of the heat pumps it is possible to win energy from sources characterized by low temperature level, too.

The construction of the heat pumps corresponds to that of the refrigerators: the basic principle is the same, however, the direction of energy conversion is reversed. In the refrigerators the heat energy extracted from the medium is liberated into the environment when cooling. The heat pump wins the energy needed for work by cooling a favourable medium and this energy can be utilized. The basically identical construction of the refrigerators and heat pumps comprises compressing means based on mechanical or thermomechanical principles (compressors or absorbers), expansion valves, evaporating units of different types, condensers etc.

It is known that the heat pumps can utilize heat

sources of temperatures near to that of freezing, they quality factor is generally as high as 2,5 to 4 depending on the temperature conditions, i.e. they are capable of producing power being 2,5 to 4 times higher than the power required for the work in every season of the year.

The heat pumps as mentioned are similar in construction to the refrigerators what means that they require connecting to a source for energizing the pressure transformer, as the motor of the compressor or the heating unit of the absorber. The source is generally the connection to an electric circuit. This is a solution forced by the conditions and this has the disadvantage that the heat pump can be used in places wherein the power required for work is disposable, e.g. by terminals of an electric network or in form of an engine.

This disadvantage can be avoided by the use of more complicated system of converting heating energy based on the heat pumps which can working in a way independent on an outer network or energy source, they require only a medium of desired temperature level.

This system can be called heat converter. The heat converter comprises a heat pump wherein the heat energy of the environment is used for heating a liquid to a temperature higher than its boiling point in order to generate a vapour used as a work medium. The vapour is utilized for actuating a turbine whereby it is possible to ensure power required for actuating the compressing means of the heat pump, e.g. a compressor. The energy output of a such heat converter is of course lower than that of a simple heat pump, however, the remaining power can moretimes overcome the power required by the compressing means, as compressor or absorber. The known heat converters comprise a heat pump and means for actuating the heat pump as a turbine supplied by vapour of a liquid of relatively low boiling point.

The heat converters of mentioned construction are

shown e.g. in the book of H. Kirn "Wärmepumpen" (edited by C. F. Müller, Karlsruhe, 181983), wherein Fig. 9-1 on page 148 represents a schematic diagram of a system realising a Clausius-Rankine-proeess.

As shown in the mentioned figure, the heat converter realising a Clausius--Rankine-process comprising a heat pump and an outer circuit. The heat pump includes according to the known principles evaporating means receiving a medium carrying a part of the heat energy of the environment, compressing means, condensing means and an expansion valve. The heat deliberated in the condensing means is transferred by the medium back to the input of the heat converter in order to heat the medium supplying the outer circuit. This circuit comprises a steam boiler actuating a steam turbine, a heat exchanger and a recirculating pump. The steam turbine drives the compressing means and the heat exchanger is capable of transmitting heat energy being disposable in the system. The main disadvantage of this heat converter is the low efficiency. It requires relatively high temperature level in order to work without outer energy supply e.g. from an electric network.

This means, the known heat converter can be installed in conditions where it requires no connection to an outer power source, e.g. an electric network and therefore it can be used in a very advantageous way far from the electric networks or other suitable power sources, if the required temperature conditions were given.

SUMMARY OF THE INVENTION

The object of the invention is to develop a heat converter system for utilizing of the heat energy with improved efficiency and especially to realise a heat converter system which can be used in an environment of temperature level below 0 ^{o}C, up to -20 ^{o}C, if desired.

The further object of the invention is to create a heat converter system which can work practically independent

on solar energy and therefore is capable of working also in wintertime. As an example of use can be mentioned that the accumulators of a vehicle can be charged thereby in a continuous process all the year having an electric circuit for charging. Another example is the possibility of temperature regulation in different types of glass-houses in any conditions of the daylight, in every season of the year and at a temperature level up to -20 °C.

Another advartageous field of agricultural use is the power production for irrigation plants: the heat converter can be installed according to the conditions of the agricultural works. A further advantageous possibility is the continuous energy supply for control systems.

The above mentioned fields of use are, of course, shown only by way of example, because the possibility of making use of the temperature of the environment for producing energy is very advantageous and especially without the necessity of connecting the system to an outer source of energy.

The construction of the improved heat converting system according to the invention is in some features similar to that of the known heat converters shown above in connection with the Clausius--Rankine-process. The essence of the invention lies in the different destination of the known elements and therefore in a different arrangement of the energy producing elements. This results in an important improvement of the efficiency in comparison to the known heat converting systems.

According to the experience and measurements at temperature level 20 °C of the environment the heat converter according to the invention renders possible to transform about 45 % of the heat energy won from the environment into heat energy output. At the output terminal the temperature of the medium amounts about 90 °C. If the temperature of the environment were as high as +100 °C the same circuit gives

temperature 90 °C at the output and with efficiency of 80 %. It should be mentioned that the heat converting system of the invention gives a considerable amount of energy at the output which can be used for selected purposes.

Hence, the invention is an improved system for converting heat energy, particularly for utilizing the heat energy of the environment, comprising a closed heat pump circuit connected to actuating means for energizing them, wherein the heat pump circuit includes evaporating means receiving heat energy of an outer medium for converting a liquid into vapour, compressing means for increasing pressure of the vapour and condensing means for restituting liquid from the compressed vapour, the system being furnished with an energy output terminal, and according to the invention it comprises a closed driving circuit being in thermal contact with the condensing means, producing thereby a superheated vapour for energizing the actuating means, the driving circuit including means for condensating the superheated vapour leaving the output of the actuating means and transporting means for forwarding the liquid to the condensing means.

It is very advantageous to form the actuating means by an expansive machine, as a vapour turbine which can be of higher power than required for actuating the compressing means. In this case the excess power can be utilized by a generator or a turbine for producing electric energy.

The output of the system can be disposable in heat exchangers, too, which are arranged either in connection with the compressing means or parallel with the actuating means.

The driving circuit can include a conduit arranged in the evaporating means or a condenser for condensing the superheated vapour.

BRIEF DESCRIPTION OF THE DRAWINGS

The improved system for converting heat energy as proposed by the invention will be better understood when considered in connection with a more detailed description showing some preferred embodiments by way of examples and with reference to the accompanying drawings. In the drawings

Figur 1 is a block diagram of a preferred embodiment of the invented system, and

Figur 2 is a block diagram of another preferred embodiment of the invented system.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The system for converting heat energy proposed by the invention (Fig. 1 and 2) comprises a heat pump forming as usual a closed circuit and a driving circuit. The heat pump includes evaporating means 1, compressing means 2, connected to actuating means 3 forming a part of the driving circuit, condensing means 4 and espanding means 5 connected in series. The heat pump and the driving circuit form two closed circuits, wherein appropriate liquids can be circulated. The heat pump is built-up according to the well-known priciples. The compressing means 2 can be constituted by a compressor driven by an engine or an absorber unit receiving heat energy generated by a heater. This means that the actuating means 3 are either an engine or a source of electric current comprising e.g. a generator driven by the engine. Of course, in given conditions it can be useful to join more compressors into one cascade according to the known principle of the refrigerators. The condensing means 4 form a condenser with or without moving parts, e.g. a surface condenser or a mixing condenser. The embodiment selected depends always on the given circumstances.

The expanding means 5 can be consisted e.g. of an expansion valve. This is an injection unit which forwards a liquid medium into the evaporating means 1, where this

liquid is evaporated by the heat extracted from the medium circulating from an input 7 and an output 8 in order to ensure the energy input of the invented system.

The actuating means 3 as mentioned are included into a driving circuit comprising an evaporating part being in thermal contact with the condensing means 4. In this part a suitable liquid is converted into vapour for supplying the actuating means 3. The vapour leaving the actuating means 3 should be condensed in an appropriate way, e.g. by means of a condenser 10 (Fig. 2) of appropriate construction or by a conduit arranged in the evaporating means 1 (Fig. 1) whereby the medium and the heat pump can take part in condensing gas leaving the actuating means 3 into liquid transported in the driving circuit by transporing means 6.

The system as invented has an energy output terminal whereby disposable energy can be gained for further use. The energy delivered at the energy output terminal depends on the outer conditions and the construction of the system. Taking into account the efficiency of the means used in both circuits the output can be as high as the input or higher depending on the quality factor of the system and the outer conditions.

The actuating means 3 should comprise at least a unit ensuring power which is necessary for actuating the compressing means 2 and the transporting means 6. As mentioned, compressing means 2 can be consisted of usual equipment of refrigerators, as compressor or absorber modified according to given conditions, if necessary. The compressor needs in driving, because it comprises a piston driven by a shaft which should be rotated. The absorber can work under heating which is ensured generally by electric current. Therefore it is an advantageous solution to apply an engine for driving either the shaft of the compressor or a generator producing electric current.

The power of the actuating means 3 can considerably overcome the power needed by the compressing means 2. The actuating means 3 constituted by an expansive machine, particularly a vapour turbine are very effective under given conditions. The turbine can be applied e.g. for driving a generator producing electric current.

Another possibility is to include a heat exchanger either parallel to the actuating means 3, or in immediate heat contact with the condensing means 4, depending on the circumstances. In this way the output energy is gained in form of heat energy.

The system as invented operates as follows.

The heat pump and the driving circuit should be filled with appropriate heat transfer substance. In the heat pump this substance can depend also on the kind of the compressing means applied, because in case of absorber ammonia should be preferred. When relying on compressor the well-known freon-based compositions can be also used. The driving circuit can be filled also with appropriate freon-based composition or other substance.

The liquid filled in the heat pump evaporates in the evaporating means 1 gaining heat from the environment by cooling the medium supplying the proposed system. The vapour is transported to the condensing means 4, wherein the heat energy accumulated in it is deliberated and transferred to the medium circulating in the driving circuit. The vapour enters the condensing means 4 under increased pressure ensured by the compressing means 2 wherein its energy can be deliberated by condensation. This energy results in evaporating liquid circulated in the driving circuit. The vapour gained serves as active medium to energizing the actuating means 3 ensuring power supply to the compressing means 2, transporting means 6 and if necessary, condenser 10. This vapour can energize also the expansive machine ensuring the energy output of the system. If desired, the energy output can be realised by heat

exchangers being in heat contact with the condensing means 4 or in parallel connection to the actuating means.

The vapour leaving the actuating means 3 and heat exchanger, if used, should be condensed. This is assured by the condenser 10 or a pipe arranged in the evaporating means 1. The last way the efficiency of the entire system can be improved, however, this is a relatively little improvement only.

The system as mentioned can comprise ammonia in the heat pump and freon-12 in the driving circuit. The qality factor of the heat pump amounts 2,6 at -20 °C, 3,5 at +20 °C. This means that the driving circuit realised with efficiency at least about 50 % as proposed by the invention can supply even in temperature -20 °C power enough for energizing the compressing means 2. Of course the proposed system should be started in an appropriate way: the compressing means have to be driven by another source during starting until the power ensured by the driving circuit reaches a level required for maintaining the continuous work of the heat pump.

According to the experience and measurements at temperature level 20 °C of the environment the heat converter according to the invention renders possible to transform about 45 % of the heat energy won from the environment into heat energy output. At the output terminal the temperature of the medium amounts about 90 °C. If the temperature of the environment were as high as +100 °C the same circuit gives temperature 90 °C at the output and with efficiency of 80 %. It should be mentioned that the heat converting system of the invention gives a considerable amount of energy at the output which can be used for selected purposes.

From the above description it should be understood that different systems equivalent to those given above will be within the scope of the claimed invention and such systems comprise units and means depending on the conditions of

application and the given circumstances - the units and means can be chosen from a relatively wide class of different embodiments, taking into account information mentioned above. Of course, the embodiment realised should depend on active media used in the heat pump and the driving circuit and according to it the different means and units can be selected.

CLAIMS:

1. System for converting heat energy, particularly for utilizing heat energy of the environment, comprising a closed heat pump circuit connected to actuating means for energizing them, wherein the heat pump circuit includes evaporating means receiving heat energy of an outer medium for converting a liquid into vapour, compressing means for increasing pressure of the vapour and condensing means for restituting liquid from the compressed vapour, the system being furnished with an energy output terminal, c h a r a c t e r i z e d in comprising a closed driving circuit being in thermal contact with the condensing means (4), producing thereby a superheated vapour for energizing the actuating means (3), the driving circuit including means for condensating the superheated vapour leaving the output of the actuating means (3) and transporting means (6) for forwarding the liquid to the condensing means (4).

2. A system as claimed in claim 1, wherein the actuating means (3) constitute an expansive machine, particularly a vapour turbine of power overcoming the power required by the compressing means (2).

3. A system as claimed in claim 1, wherein the energy output terminal constitutes a heat exchanger (9) connected to the condensing means (4).

4. A system as claimed in claim 1, wherein the energy output terminal constitutes a heat exchanger arranged in parallel with the actuating means (3).

5. A system as claimed in any of claims 1 to 4, wherein the driving circuit includes a conduit arranged in the evaporating means for condensing the superheated vapour.

6. A system as claimed in any of claims 1 to 4, wherein the driving circuit includes a condenser (10).

7. A system as claimed in claim 1 or 2, wherein the actuating means (3) are coupled with a generator producing

electric current and transporting means (6) are energized by electric power produced by the actuating means (3).

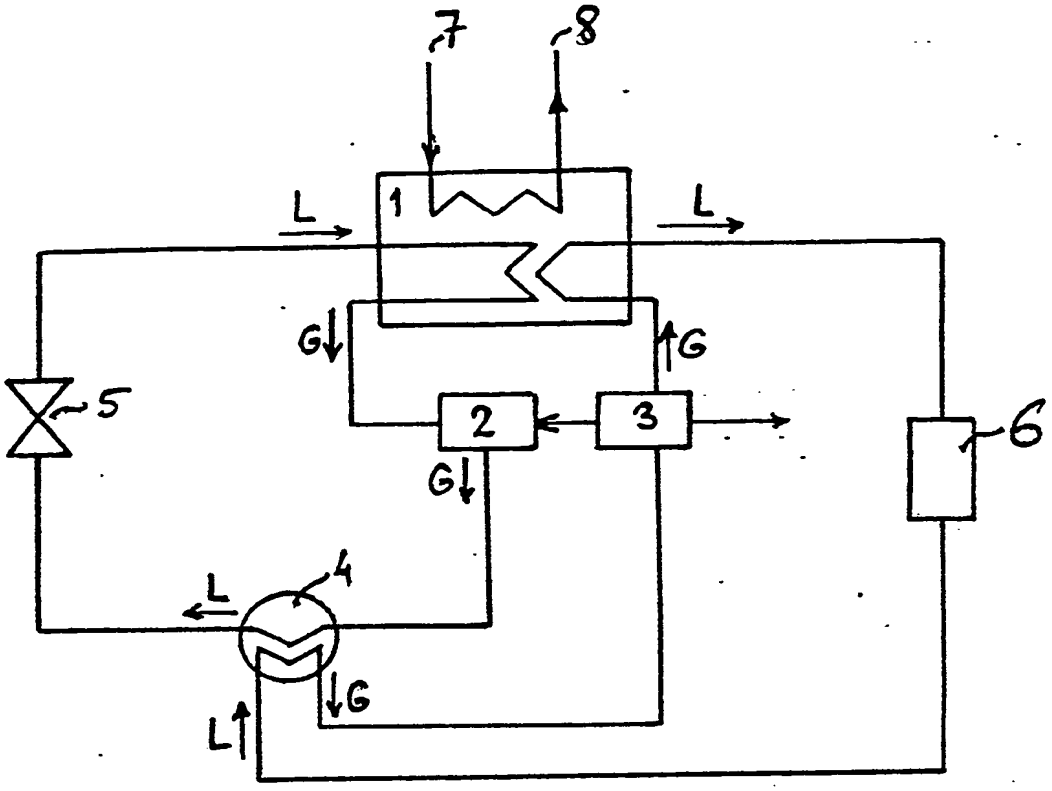

Fig. 1.

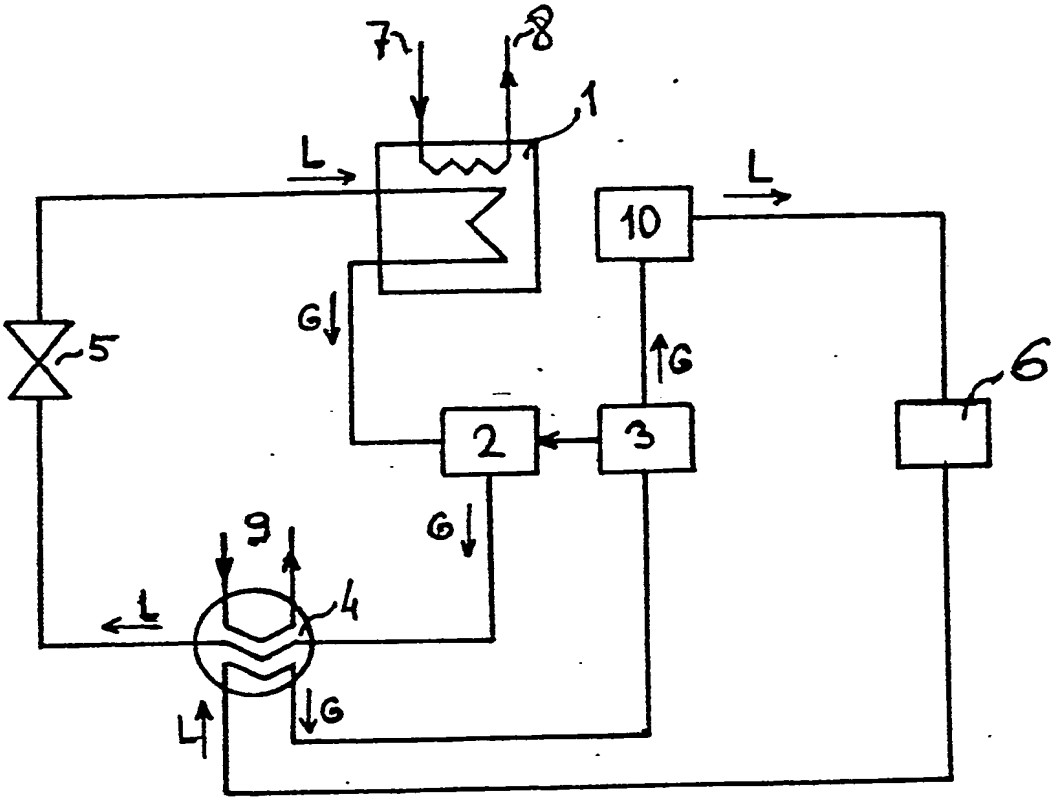

Fig. 2.

INTERNATIONAL SEARCH REPORT

International Application No PCT/HU 84/00067

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: F 01 K 23/04, F 01 K 25/10, F 25 B 29/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
Int.Cl.[4]	F 01 K 23/00, 25/00; F 25 B 7/00, 11/00, 13/00, 29/00

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	DE, A1, 2 402 557 (HÄBERLE) 24 July 1975 (24.07.75), see fig. 2; page 7; page 8, line 1.	(1,2,5,6)
A	GB, A, 2 073 862 (GLYNWED) 21 October 1981 (21.10.81), see whole document.	(1,2,3)
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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
18 March 1985 (18.03.85)	25 March 1985 (25.03.85)
International Searching Authority	**Signature of Authorized Officer**
AUSTRIAN PATENT OFFICE	p. Licnia Rabe

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Anhang zum internationalen Recherchenbericht über die internationale Patentanmeldung Nr.

In diesem Anhang sind die Mitglieder der Patentfamilien der im obengenannten internationalen Recherchenbericht angeführten Patentdokumente angegeben. Diese Angaben dienen nur zur Unterrichtung und erfolgen ohne Gewähr.

Annex to the International Search Report on International Patent Application No. PCT/HU 84/00067

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned International search report. The Austrian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Annexe au rapport de recherche internationale relatif à la demande de brevet international n°.

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